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1 A signal-processing framework for reflection

Ravi Ramamoorthi, Pat Hanrahan

October 2004 **ACM Transactions on Graphics (TOG)**, Volume 23 Issue 4

Full text available: pdf(272.24 KB) Additional Information: full citation, abstract, references, index terms

We present a signal-processing framework for analyzing the reflected light field from a homogeneous convex curved surface under distant illumination. This analysis is of theoretical interest in both graphics and vision and is also of practical importance in many computer graphics problems---for instance, in determining lighting distributions and bidirectional reflectance distribution functions (BRDFs), in rendering with environment maps, and in image-based rendering. It is well known that und ...

Keywords: BRDF, Fourier analysis, environment maps, illumination, inverse rendering, reflection, signal processing, spherical harmonics

2 Image-based skin color and texture analysis/synthesis by extracting hemoglobin and melanin information in the skin

Norimichi Tsumura, Nobutoshi Ojima, Kayoko Sato, Mitsuhiro Shiraishi, Hideto Shimizu, Hirohide Nabeshima, Syuuichi Akazaki, Kimihiko Hori, Yoichi Miyake

July 2003 **ACM Transactions on Graphics (TOG)**, Volume 22 Issue 3

Full text available: pdf(2.81 MB) Additional Information: full citation, abstract, references, index terms

This paper proposes an E-cosmetic function for digital images based on physics and physiologically-based image processing. A practical skin color and texture analysis/synthesis technique is introduced for this E-cosmetic function. Shading on the face is removed by a simple color vector analysis in the optical density domain as an inverse lighting technique. The image without shading is analyzed by a previously introduced technique that extracts hemoglobin and melanin components by independent co ...

Keywords: hemoglobin, independent component analysis, inverse lighting, melanin, physiologically-based rendering, pyramid-based texture analysis and synthesis, skin color, skin texture

3 Synthesizing bidirectional texture functions for real-world surfaces

Xinguo Liu, Yizhou Yu, Heung-Yeung Shum

August 2001 **Proceedings of the 28th annual conference on Computer graphics and**

interactive techniques

Full text available: pdf(4.30 MB) Additional Information: full citation, abstract, references, citings, index terms

In this paper, we present a novel approach to synthetically generating bidirectional texture functions (BTFs) of real-world surfaces. Unlike a conventional two-dimensional texture, a BTF is a six-dimensional function that describes the appearance of texture as a function of illumination and viewing directions. The BTF captures the appearance change caused by visible small-scale geometric details on surfaces. From a sparse set of images under different viewing/lighting settings, our approach g ...

Keywords: bidirectional texture functions, image-based rendering, photometric stereo, reflectance and shading models, shape-from-shading, texture synthesis

4 Lightfield acquisition & display: DISCO: acquisition of translucent objects

Michael Goesele, Hendrik P. A. Lensch, Jochen Lang, Christian Fuchs, Hans-Peter Seidel

August 2004 **ACM Transactions on Graphics (TOG)**, Volume 23 Issue 3

Full text available: pdf(526.75 KB) mov(24:20 MIN) Additional Information: full citation, abstract, references, index terms

Translucent objects are characterized by diffuse light scattering beneath the object's surface. Light enters and leaves an object at possibly distinct surface locations. This paper presents the first method to acquire this transport behavior for arbitrary inhomogeneous objects. Individual surface points are illuminated in our DISCO measurement facility and the object's impulse response is recorded with a high-dynamic range video camera. The acquired data is resampled into a hierarchical model of ...

Keywords: Acquisition, BSSRDF, Reflection Model, Subsurface Scattering, Translucency

5 Image-based reconstruction of spatial appearance and geometric detail

Hendrik P. A. Lensch, Jan Kautz, Michael Goesele, Wolfgang Heidrich, Hans-Peter Seidel

April 2003 **ACM Transactions on Graphics (TOG)**, Volume 22 Issue 2

Full text available: pdf(302.22 KB) Additional Information: full citation, abstract, references, citings, index terms

Real-world objects are usually composed of a number of different materials that often show subtle changes even within a single material. Photorealistic rendering of such objects requires accurate measurements of the reflection properties of each material, as well as the spatially varying effects. We present an image-based measuring method that robustly detects the different materials of real objects and fits an average bidirectional reflectance distribution function (BRDF) to each of them. In or ...

Keywords: BRDF measurement, normal map acquisition, photometric stereo, shape from shading, spatially varying BRDFs

6 Inverse global illumination: recovering reflectance models of real scenes from photographs

Yizhou Yu, Paul Debevec, Jitendra Malik, Tim Hawkins

July 1999 **Proceedings of the 26th annual conference on Computer graphics and interactive techniques**

Full text available: pdf(475.61 KB) Additional Information: full citation, references, citings, index terms

Keywords: BRDF models, albedo maps, global illumination, image-based modeling and rendering, radiance, radiosity, reflectance recovery, rendering

7 Modeling and rendering of metallic patinas
Julie Dorsey, Pat Hanrahan
August 1996 **Proceedings of the 23rd annual conference on Computer graphics and interactive techniques**
Full text available: pdf(378.55 KB) Additional Information: full citation, references, citings, index terms

Keywords: material models, reflection models, time-dependent phenomena, weathering and appearance

8 Reflection from layered surfaces due to subsurface scattering
Pat Hanrahan, Wolfgang Krueger
September 1993 **Proceedings of the 20th annual conference on Computer graphics and interactive techniques**
Full text available: pdf(707.86 KB) Additional Information: full citation, references, citings, index terms

Keywords: Monte Carlo, integral equations, reflection models

9 Measurement and color matching: Efficient isotropic BRDF measurement
Wojciech Matusik, Hanspeter Pfister, Matthew Brand, Leonard McMillan
June 2003 **Proceedings of the 14th Eurographics workshop on Rendering**
Full text available: pdf(5.65 MB) Additional Information: full citation, abstract, references, citings

In this paper we present novel reflectance measurement procedures that require fewer total measurements than standard uniform sampling approaches. First, we acquire densely sampled reflectance data for a large collection of different materials. Using these densely sampled measurements we analyze the general surface reflectance function to determine the local signal variation at each point in the function's domain. We then use wavelet analysis to derive a common basis for all of the acquired refl ...

10 Two methods for display of high contrast images
Jack Tumblin, Jessica K. Hodgins, Brian K. Guenter
January 1999 **ACM Transactions on Graphics (TOG)**, Volume 18 Issue 1
Full text available: pdf(10.28 MB) Additional Information: full citation, abstract, references, citings, index terms, review

High contrast images are common in night scenes and other scenes that include dark shadows and bright light sources. These scenes are difficult to display because their contrasts greatly exceed the range of most display devices for images. As a result, the image constrasts are compressed or truncated, obscuring subtle textures and details. Humans view and understand high contrast scenes easily, "adapting" their visual response to avoid compression or truncation with no apparent ...

Keywords: adaptation, tone reproduction, visual appearance

11 Real-time rendering of translucent meshes

Xuejun Hao, Amitabh Varshney
April 2004 **ACM Transactions on Graphics (TOG)**, Volume 23 Issue 2

Full text available: pdf(4.66 MB) Additional Information: full citation, abstract, references, index terms

Subsurface scattering is important for photo-realistic rendering of translucent materials. We make approximations to the BSSRDF model and propose a simple lighting model to simulate the effects on translucent meshes. Our approximations are based on the observation that subsurface scattering is relatively local due to its exponential falloff.In the preprocessing stage we build subsurface scattering neighborhood information, which includes all the vertices within effective scattering range from ea ...

Keywords: BSSRDF, local illumination, reflection models, subsurface scattering

12 Monte Carlo techniques for direct lighting calculations

Peter Shirley, Changyaw Wang, Kurt Zimmerman
January 1996 **ACM Transactions on Graphics (TOG)**, Volume 15 Issue 1

Full text available: pdf(9.20 MB) Additional Information: full citation, abstract, references, citings, index terms, review

In a distributed ray tracer, the sampling strategy is the crucial part of the direct lighting calculation. Monte Carlo integration with importance sampling is used to carry out this calculation. Importance sampling involves the design of integrand-specific probability density functions that are used to generate sample points for the numerical quadrature. Probability density functions are presented that aid in the direct lighting calculation from luminaires of various simple shapes. A method ...

Keywords: Monte Carlo integration, direct lighting, importance sampling, luminaires, ray tracing, realistic image synthesis

13 Interactive multi-pass programmable shading

Mark S. Peercy, Marc Olano, John Airey, P. Jeffrey Ungar
July 2000 **Proceedings of the 27th annual conference on Computer graphics and interactive techniques**

Full text available: pdf(5.99 MB) Additional Information: full citation, abstract, references, citings, index terms

Programmable shading is a common technique for production animation, but interactive programmable shading is not yet widely available. We support interactive programmable shading on virtually any 3D graphics hardware using a scene graph library on top of OpenGL. We treat the OpenGL architecture as a general SIMD computer, and translate the high-level shading description into OpenGL rendering passes. While our system uses OpenGL, the techniques described are applicable to any retained mode i ...

Keywords: OpenGL, graphics hardware, graphics systems, illumination, interactive rendering, languages, multi-pass rendering, non-realistic rendering, procedural shading, programmable shading, rendering, texture mapping, texture synthesis

14 Session 3: light: Interactive subsurface scattering for translucent meshes

Xuejun Hao, Thomas Baby, Amitabh Varshney
April 2003 **Proceedings of the 2003 symposium on Interactive 3D graphics**

Full text available: pdf(19.67 MB) Additional Information: full citation, abstract, references, citings, index terms

We propose a simple lighting model to incorporate subsurface scattering effects within the

local illumination framework. Subsurface scattering is relatively local due to its exponential falloff and has little effect on the appearance of neighboring objects. These observations have motivated us to approximate the BSSRDF model and to model subsurface scattering effects by using only local illumination. Our model is able to capture the most important features of subsurface scattering: reflection an ...

Keywords: BSSRDF, local illumination, reflection models, subsurface scattering

15 Linear light source reflectometry

Andrew Gardner, Chris Tchou, Tim Hawkins, Paul Debevec
July 2003 **ACM Transactions on Graphics (TOG)**, Volume 22 Issue 3

Full text available: pdf(12.74 MB) Additional Information: full citation, abstract, references, citings

This paper presents a technique for estimating the spatially-varying reflectance properties of a surface based on its appearance during a single pass of a linear light source. By using a linear light rather than a point light source as the illuminant, we are able to reliably observe and estimate the diffuse color, specular color, and specular roughness of each point of the surface. The reflectometry apparatus we use is simple and inexpensive to build, requiring a single direction of motion for t ...

16 Rendering: Interactive rendering of translucent deformable objects

Tom Mertens, Jan Kautz, Philippe Bekaert, Hans-Peter Seidelz, Frank Van Reeth
June 2003 **Proceedings of the 14th Eurographics workshop on Rendering**

Full text available: pdf(3.04 MB) Additional Information: full citation, abstract, references, citings, index terms

Realistic rendering of materials such as milk, fruits, wax, marble, and so on, requires the simulation of subsurface scattering of light. This paper presents an algorithm for plausible reproduction of subsurface scattering effects. Unlike previously proposed work, our algorithm allows to interactively change lighting, viewpoint, subsurface scattering properties, as well as object geometry.The key idea of our approach is to use a hierarchical boundary element method to solve the integral describi ...

17 Image-based transparency and refraction: Acquisition and rendering of transparent and refractive objects

Wojciech Matusik, Hanspeter Pfister, Remo Ziegler, Addy Ngan, Leonard McMillan
July 2002 **Proceedings of the 13th Eurographics workshop on Rendering**

Full text available: pdf(16.22 MB) Additional Information: full citation, abstract, references, citings, index terms

This paper introduces a new image-based approach to capturing and modeling highly specular, transparent, or translucent objects. We have built a system for automatically acquiring high quality graphical models of objects that are extremely difficult to scan with traditional 3D scanners. The system consists of turntables, a set of cameras and lights, and monitors to project colored backdrops. We use multi-background matting techniques to acquire alpha and environment mattes of the object from mul ...

18 Homomorphic factorization of BRDF-based lighting computation

Lutz Latta, Andreas Kolb
July 2002 **ACM Transactions on Graphics (TOG) , Proceedings of the 29th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 3

Full text available: pdf(2.81 MB) Additional Information: full citation, abstract, references, citings, index terms

Several techniques have been developed to approximate Bidirectional Reflectance Distribution Functions (BRDF) with acceptable quality and performance for realtime

applications. The recently published *Homomorphic Factorization* by McCool et al. is a general approximation approach that can be used with various setups and for different quality requirements.In this paper we propose a new technique based on the Homomorphic Factorization. Instead of approximating the BRDF, our technique factoriz ...

Keywords: illumination, reflectance & shading model, rendering, rendering hardware, texture mapping

19 Towards interactive bump mapping with anisotropic shift-variant BRDFs

Jan Kautz, Hans-Peter Seidel

August 2000 **Proceedings of the ACM SIGGRAPH/EUROGRAPHICS workshop on Graphics hardware**

Full text available: pdf(3.98 MB) Additional Information: full citation, abstract, references, citings, index terms

In this paper a technique is presented that combines interactive hardware accelerated bump mapping with shift-variant anisotropic reflectance models. An evolutionary path is shown how some simpler reflectance models can be rendered at interactive rates on current low-end graphics hardware, and how features from future graphics hardware can be exploited for more complex models. We show how our method can be applied to some well known reflectance models, namely the Banks model, War ...

20 Frequency space environment map rendering

Ravi Ramamoorthi, Pat Hanrahan

July 2002 **ACM Transactions on Graphics (TOG) , Proceedings of the 29th annual conference on Computer graphics and interactive techniques**, Volume 21 Issue 3

Full text available: pdf(3.37 MB) Additional Information: full citation, abstract, references, citings, index terms

We present a new method for real-time rendering of objects with complex isotropic BRDFs under distant natural illumination, as specified by an environment map. Our approach is based on spherical frequency space analysis and includes three main contributions. Firstly, we are able to theoretically analyze required sampling rates and resolutions, which have traditionally been determined in an ad-hoc manner. We also introduce a new compact representation, which we call a *spherical harmonic reflec ...*

***Keywords**: complexity analysis, environment maps, image-based rendering, signal-processing, spherical harmonics*

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